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GAS ABSTRACTS

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1. GAS INDUSTRY

Federal Power Commission

Ozanne, H. INDUSTRY BACKS PROPOSAL TO CURB FEDERAL POWER COMMISSION POWERS IN SALES OF NATURAL GAS. *World Oil* **129**, 38, 42 (1949) *July.*

The proposal to amend the Natural Gas Act to exempt from the Federal Power Commission's jurisdiction "arm's length" sales of natural gas by producers and gatherers to pipeline companies has the support of the gas industry and a minority of two of the Commission's five members. Proponents of the proposal hold that Congress never intended such regulation, that regulation of independent natural gas producers would also subject their oil operations to regulation, that the producers fear having their returns limited to 6% which would not carry the burden of other losing investments, that this fear is detrimental to gas conservation, since such producers refuse to sell to pipe line companies to avoid possible regulation, and that freedom from regulation would make more gas available thus reducing the price to the consumer. Commissioner Olds contends that only some 10% of the natural gas producers should be regulated, but that the Federal Power Commission should have the power to decide where to apply federal controls. He argues that a producer who sells or who has ever sold natural gas into interstate commerce has "dedicated" his reserves to public utility service and is therefore properly subject to regulation, "escape" clauses in his contracts notwithstanding.

J. C. Lane

Manufactured Gas Industry

East, L. H. OUTLOOK FOR THE MANUFACTURED GAS INDUSTRY. PART I. SPECIAL REFERENCE TO NATURAL GAS. *Gas Age* **104**, 21-24, 60, 62 (1949) *July* 21.

The manufactured gas industry will continue to grow at its present rate and the mixed gas industry will show an increased rate of growth, while the natural gas industry's current rapid rate of growth will decrease somewhat within the next few years. This prediction is in conflict with that recently made by the National Security Resources Board which predicted a continued rapid growth for the natural gas industry and a decline in the manufactured gas industry beginning in 1951 or 1952. Supplies of natural gas in all but the producing areas are now limited to a fraction of the potential demand by lack of adequate pipe line facilities. Barring a substantial change in the competitive price situation, the demand for straight natural gas probably will continue to lag far behind the quantities which can be economically supplied. It therefore seems that manufactured gas companies should use natural gas as an enricher rather than converting to straight natural gas. Examples are given of the very substantial increases in capacity which can be attained by blending coke oven gas with producer gas and enriching with natural gas to obtain an interchangeable gas. Examples are also given of blue gas dilution with producer gas followed by natural gas enrichment.

J. C. Lane

2. APPLIANCES

Heat Pump

Wetherbee, G. D. OPERATING DATA ON HEAT PUMP SHOWS APPLICATION OF METHOD. *Heating, Piping & Air Conditioning* **21**, 91-92 (1949) *July.*

This first article of a series presents an outline of some of the operating results such as total operating time per day and kwhr consumption during initial operation of an experimental heat pump installation. More data will be presented in the future.

E. F. Davis

LP-Gas

SAFE OPERATION WITH APPROVED APPLIANCES AND HOUSE PIPING CORRECTLY INSTALLED. *Butane Propane News* **11**, 72-96, 101-102, 104 (1949) *June.*

Complete details are given for the proper methods of selecting, testing, installing and servicing domestic gas appliances for use with LP-gas and LP-gas and air mixtures. Gas orifice size charts give the proper orifice size

for all domestic ranges using any of the various LP-mixtures. In addition, the methods for installing both underground and aboveground storage tanks and service piping for (1) domestic, (2) commercial, and (3) industrial installations are given.

E. F. Davis

Ranges

Patch, P. J. (assigned to the Rocky Mountain Gas Equipment Co.) GAS BURNER AND PILOT. U. S. 2,474,547 (1949) June 28.

Four claims are made for a gas burner with a pilot tube inserted through the burner head and a thermopile for safety shut-off inserted inside the pilot tube. In this type of safety pilot the flame surrounds the thermopile rather than impinging directly on it.

E. F. Davis

Rowan, M. SAFETY THERMOSTATIC CONTROL FOR GASEOUS BURNERS. U. S. 2,470,269 (1949) May 17.

One claim is made for a bi-metallic thermal element immersed in a range pilot flame and which will mechanically shut off the gas to the burner manifold in case of pilot failure.

E. F. Davis

Salinger, G. T. A NEW SAFE IGNITION EQUIPMENT. *Gas Heat in Ind.* (British) **1949**, 282-284 (*July*).

A safety pilot is described which employs a rod and tube bimetallic thermal element which is more sensitive than the thermoelectric units. Shut-off is provided on the main burner as well as the pilot. Initial lighting and reset are manual operations.

E. F. Davis

Space Heating

Hassmer, W. L. and Schlachter, O. E. (assigned to Affiliated Gas Equipment, Inc.) GAS BURNER. U. S. 2,475,240 (1949) July 5.

Two claims are made for a slotted port conversion burner head with a collar surrounding the burner ports to direct or restrict the secondary air flow into the flame. The collar serves as a spreader to give the flame greater length by retarding the flow of secondary air.

E. F. Davis

Venting

Dean, C. H. APPLIANCE VENTING STANDARDS STILL REMAIN AN UNRESOLVED UTILIZATION PROBLEM. *Am. Gas J.* **171**, 10-11, 38 (1949) *July*.

In this first of a series of articles the author appeals to the gas utilities to get together for the purpose of formulating and enforcing a code for the venting of gas appliances before city ordinances bind the installation requirements to such an extent as to impede the use of gas. Specific recommendations are set forth.

E. F. Davis

3. COMBUSTION AND INDUSTRIAL FURNACES

Atmospheres

Groves, W. T. DEW POINT VS. % CO_2 AS FURNACE ATMOSPHERE CONTROL CHECK. *Ind. Heating* **16**, 966-970, 972, 974, 976, 978, 980, 1086 (1949) *June*.

Several of the gas equilibrium equations formulated by others have been used to prepare charts showing the relationships existing between the gaseous constituents of common prepared atmospheres and the carbon concentration of the steel in contact with them. The relationship is demonstrated in a readily understandable manner, so that the average heat treater can evaluate his atmosphere in terms of CO_2% and dew point.

E. F. Davis

Burners

HYPACT BURNERS. *Gas Heat in Ind.* (British) **1949**, 286-288, 290, 292, 294, 296 (*June*).

The principle of two small jets impinging upon each other to give a flat flame is developed in the "industrial jet" by using a slot in place of two separate holes. The approach to the slot is shaped in such a way that the two streams of

gas impinge on the flame from opposite sides, giving it a characteristic fan shape. This flame has a large surface which enables the combustion of gas in a smaller space than would otherwise be possible.

E. F. Davis

Carburization

Heyn, H. M. PRODUCTION LINE HEAT TREATING. *Ind. Gas* 27, 5-7, 24 (1949) *March.*

"Barrel carburization" is the most recent development of Surface Combustion research and is here announced for the first time. Many parts previously carburized in batch or continuous furnaces may now be carburized in "barrels" in much the same way as parts may be rotated in barrels for cleaning and electroplating. The entire process is automatic from hopper loading to hopper discharging. The parts are heated, carburized, quenched, washed, reheated, quenched and drawn by a continuous method.

Author's abstract

Combustion

Brinsley, F. CONTROLLING THE COMBUSTION OF TOWN GAS. *Gas World* (British) 130, 1127-1129 (1949) *July* 2.

The "Calyx" flame is a separate purple flame at the base of the main flame which appears only when the proper amount of air is premixed with the gas prior to burning. A simple burner with a glass shield is used to detect the combustion conditions in furnaces by burning a small quantity of the mixture in this burner. The accuracy is said to be $\pm 15\%$.

E. F. Davis

Keillor, R. D. A PROPOSED NEW CALORIMETER. *Gas World* (British) 130, 944-945 (1949) *June* 4.

A new type of calorimeter has been designed to measure the utilization efficiency of various gases and burners. It is expected that the unit will serve as a standard for the industry to give special reference to (1) the volume of air additional to theoretical required to preserve satisfactory CO/CO_2 ratio in combustion products, (2) the practical range of gross Btu input per cu in. of combustion chamber space, and (3) the quantity of heat remaining in combustion products after specific heating functions have been accomplished.

E. F. Davis

Lewis, B. REPORT OF RESEARCH AND TECHNOLOGIC WORK ON EXPLOSIVES, EXPLOSIONS, AND FLAMES: FISCAL YEARS 1947 AND 1948. U. S. Bureau of Mines Report of Investigations 4502 (1949) July.

The activities of the Explosives Branch of the Bureau of Mines, covering the period July 1, 1946 to June 30, 1948, are reported. The subject matter is largely taken from original publications of the Bureau. Descriptions of flame and combustion studies and tests of the flammability of gases and vapors are included.

A. J. Rudnitzki

Foundry Operations

Jennings, A. C. THE USE OF GAS IN FOUNDRIES. *Gas World* (British) 130, *Supplement* 66-72 (1949) *June* 25; *Gas Heat in Ind.* (British) 1949, 278-282 (*June*).

Mention is made of 22 applications of gas to foundry operations. They include: sand drying, cone baking, use of torches to dry cones, drying ladles, preheating ladles, annealing and heating water. Pictures of each application are included.

E. F. Davis

Inflammability

Jones, E. PREVENTION OF GAS EXPLOSIONS IN CHEMICAL MANUFACTURING PLANTS. *J. Soc. Chem. Ind.* (British) 68, 117-118 (1949) *April.*

The usual methods of eliminating inflammability hazards, by (1) employing excess gas or excess air and (2) by the addition of inert gases, often require inconveniently large additions of the diluents. A consideration of the limits of inflammability of mixtures indicates

that comparatively small additions of an inflammable gas having a low upper limit of inflammability offer more effective means of eliminating the inflammability hazards. Thus, CH_4 is shown to be a powerful flame suppressing agent for stoichiometric mixtures of H_2 and air. For such H_2-air mixtures, the percentages of diluent gases in the upper limit mixtures formed by the conventional methods and by the present method are compared: 86% for air, 65% for H_2, 67% for N_2 and only 10% for CH_4.

A. J. Rudnitzki

4. CARBONIZATION AND GASIFICATION

Coal Properties

McCulloch, A. and Sherlock, E. GRAPHICAL STUDIES OF THE PROPERTIES OF ALBERTA COALS. *Fuel* (British) 28, 135-141 (1949) *June.*

Coals of Alberta were plotted on the Seyler and Mott type of graphs, (volatile matter % vs. Btu/lb and % carbon vs % hydrogen). The band for Alberta coals deviates from Motts by a mean of 200 Btu/lb for coals of over 15000 Btu/lb and by 4% volatile matter for coals 12250 to 14000 Btu/lb. The mean deviation of determined calorific value from calorific value calculated by Mott's formula increases up to about 100 Btu/lb as the rank increases. The coal band plot for this restricted coal region thus differs from the general world coal band in a fundamental way, not yet explainable. Components other than vitrinite are present and the vitrinous components have a more widely variable hydrogen content than Seyler's theory suggests, although these variations from Seyler [see "Ultrafine Structure of Coals & Cokes," BCURA, p. 270-289 (1944)] must be more directly confirmed. The capacity (natural bed) moisture content of Alberta coals *varies in a stepwise manner* with carbon content up to 86% C, where a limiting value of 2% moisture is attained. The capacity moisture for only petrologically comparable coals *can only assume certain limiting values, which decrease discontinuously* with increase in rank up to 86%. Capacity moisture, in coals above this rank, becomes constant at about 2% until coals of anthracitic type are approached, where it rises again.

O. P. Brysch

Perch, M. and Russell, C. C. A STUDY OF COAL CLASSIFICATION AND ITS APPLICATION TO THE COKING PROPERTIES OF COAL. TP 2584. *Mining Eng.* 184, *Trans Section*, 205-214 (1949) *June.*

The ASTM classification of coals is reviewed, and graphs are presented showing variations of moisture, calorific value and porosity with rank. By plotting the dry, mineral-matter-free volatile matter plus moisture vs the ratio of the moist, mineral-matter free Btu to dry, mineral-matter-free volatile matter, the authors show that typical coals lie in a relatively narrow band. Photographs are shown of three-dimensional plots relating maximum Gieseler fluidity, expansion pressure, and tumbler stability to the above coordinates. By-product yields were also found to be related to the dry mineral-matter free volatile matter plus moisture. The authors conclude that exact correlation of coal rank with coking behavior has not been achieved, but the procedure described now makes it possible to determine the various causes for the lack of correlation.

W. E. Ball

Russell, C. C. and Perch, M. STUDIES ON THE PLASTIC PROPERTIES OF COAL AS RELATED TO COAL CARBONIZATION. Paper presented at the American Gas Association Production and Chemical Conference, New York, N. Y., May 23-25, 1949.

One of the major difficulties in finding any relation between the plastic properties of coal and its "coking property" has been the lack of some other signficant or reproducible property of coal or coke with which correlations could be made. Laboratory tests of coal are usually made under conditions in no way comparable to those existing in coke ovens. Also "coking property" is of necessity expressed as a physical quality of commercial coke. The authors have used the Gieseler plastometer as a laboratory test and the movable-wall oven as a semi-plant scale test in an extensive series of coking

tests. The test methods are described. By modifying the standard ASTM classification the authors previously had developed an approximate relationship of coking properties to coal rank, e.g., the Gieseler initial-softening temperature and temperature of maximum fluidity both decrease with decrease in rank. The actual fluidity, however, passes from zero for coals below 20% dry, mineral-matter-free volatile matter + moisture through a maximum for coals of about 40% dry, mineral-matter-free volatile matter + moisture and back to zero with coals above 50% dry, mineral-matter-free volatile matter + moisture. A four-quadrant plot which shows maximum fluidity, moveable-wall oven pressure, and rank of coal indicates a general relationship. Here the increase in coal rank accompanies the increase in maximum fluidity, but with almost no change in the low carbonization pressures. After the peak of maximum fluidity is passed and the coal rank increases into 35% or less in volatile matter, the pressures increase rapidly, reaching a maximum yet undetermined at the lower edge of the low volatile group, and then drop back to zero for the non-coking anthracitic coals. The Gieseler plastometer also has been used to study effects of oxidation of coal on plastic properties. Rapid decrease in degree of maximum fluidity, and increase in initial softening temperature were noted with increasing oxidation. Successive injections of compressed nitrogen into the center of the oven charge gave sharp corresponding pressure peaks on the moveable wall, indicating the existence of a continuous, "self-healing" plastic envelope up to the time of "setting" of the charge. A deep coke-breeze layer charged on top of the coal prevented formation of the envelope, and of high pressures. From a knowledge of temperature limits and plastic range of Gieseler tests, and of temperature progression in the moveable-wall oven, a formula was derived for determining the thickness of the plastic seam at various stages of the coking process. Wide plastic ranges give thick plastic seams and increase in rate of temperature progression give thinner seams.

O. P. Brysch

Seyler, C. A. and Edwards, W. J. TECHNIQUE OF COAL PETROGRAPHY. *Fuel* (British) 28, 121-127 (1949) *June.*

A technique of quantitative petrological analysis of coal is described. The use of cedar oil immersion lenses with the Berek microphotometer permits measurement of the *reflectance* of each component in ordinary coal, and with an integrating stage, the per cent by volume of each can be determined. The reflectances measured upon many coals of the world *vary in a step-wise manner* over only *nine steps* in passing from lignite to anthracite, from 0.26 to 4.17% of the incident light, respectively. A more detailed treatment of the results of the method appeared in "Proceedings of Conference on the Ultra-fine Structure of Coals & Cokes" British Coal Utilization Research Assoc., 1944, p. 270-289.

O. P. Brysch

Coke Manufacture

Brandon, G. E. (assigned to Allied Chemical & Dye Corp.) PROCESS OF COKING HIGH VOLATILE COAL INVOLVING INCORPORATION THEREIN OF A LIMITED AMOUNT OF BLAST FURNACE FLUE DUST. U. S. 2,473,987 (1949) June 21.

The author proposes mixing from 3% to 10% of blast-furnace flue dust with blends of high- and low-volatile bituminous coals, with not less than 15%, and not more than 50% of the latter in the blend, to obtain a large, strong coke upon conventional carbonization in high temperature coke ovens, such coke being advantageous for blast furnace use.

O. P. Brysch

Coke Ovens

Minchin, L. T. NEW COKE OVENS AT KIEL DESIGNED FOR STEAMING. *Gas World* (British) 130, *"Supplement"* 73-77 (1949) *June* 4.

In order to increase flexibility of gas make, these ovens were provided with steam inlets, making possible the production of water gas in the coke oven itself. The steam is first superheated by coils imbedded in the end walls. It

is then conducted through two manifolds under each sole, from which branch channels are taken off at 3 ft intervals. From each of these, two downward inclined jets conduct the steam into the oven near the bottom. Steaming is prolonged for as much as 12 hrs producing a high-grade water gas of 305 Btu. The steam prevents the formation of scurf on the inside of the chambers.

W. E. Ball

Kerr, H. FACTORS INFLUENCING THE LIFE OF VERTICAL RETORTS. *Gas J.* (British) 258, 610, 613-614, 619-620 (1949) *June* 15.

The author gives data and illustrations of brickwork damage on vertical intermittent retorts. He briefly discusses coke oven damage. Factors which contribute to brickwork damage are swelling pressure of coals and ash fusing temperature of coals. Degree of spalling, degree of alkali attack, local overheating caused by air or gas leaks through cracks, deposition of scurf, and efficient maintenance are discussed from the viewpoint of recent coal and ceramic research.

O. P. Brysch

Concrete in Gas Plants

Routley, T. E. THE DESIGN OF GAS WORKS PLANT IN REINFORCED CONCRETE. *Natl. Gas Bull.* (Australia) 13, 7-12 (1949) *March-April.*

The article first treats briefly of care in selection of concrete materials and in placing of the mixture. It then covers in fair detail the design and construction of two sizes of reinforced concrete oxide-boxes. The smaller size was 12 ft by 12 ft by 4½ ft deep with 12 in. thick walls. The sides are pre-cast as single plates with extended bolting-edges and grid-supporting lugs cast in place. These sides are set up in a groove in the foundation slab which is poured in place. The larger boxes were 30 ft by 30 ft by 6 ft deep. The walls here were cast in place in the groove in the pre-formed foundation slab. They were turned inward 1½ ft around the top to form a platform or "balcony" upon which angle-irons were caulked and bolted as a seating for the iron cover. The author suggests that concrete foundation slabs be substituted for cast-iron bottom plates in the future, with the iron side-plates set into grooves in the slab. The author describes a successfully-joined, 6 ft concrete extension on an old brick tank 102 ft in diameter.

O. P. Brysch

Holders

Plotegher, F. CONTRIBUTION A L'ETUDE DES "GOMMES DU GAZ". PART II. ETUDE DE LA FORMATION DES GOMMES. *J. Des Usines A Gaz* 73, 79-83 (1949) *April.* (In French)

The catalytic polymerization of cyclopentadiene, butadiene, isoprene, amylene and styrene at low concentrations in gases has been studied. It was shown that NO and oxygen, or NO_2 are effective catalysts. Oxygen alone is a less effective catalyst and NO alone does not catalyze the polymerization. It was shown that gum formation in the temperature range between 15 and 45°C is appreciably accelerated by increasing temperatures. Suppression of gum formation in gas by the elimination of NO is discussed and it is recommended that careful attention be given to the elimination of air in the holder.

S. Katz

Oil Evaluation

Evans, G. E. GAS ENRICHMENT OIL. *Gas Age* 104, 26-29, 60, 62 (1949) *July* 7.

Methods of evaluating gas enrichment oils and economic factors in the present and future supply are discussed from the view point of the oil industry. The diesel index (0.01 x °API x ASTM aniline point) is suggested for an index of relative distillate oil quality while the API gravity is employed for residual oils in the 25-200 Furol seconds viscosity range. However, the author considers the Dick cracking test as the most reliable index for oil purchasing. The effects of refinery operation trends on the availability and cost of gas enrichment oils are also discussed.

H. R. Linden

Linden, H. R. METHODS OF ESTIMATING OIL GASIFICATION YIELDS. Paper presented at the American Gas Association Production and Chemical Conference, New York, N.Y., May 23-25, 1949.

The enriching value or Btu recovery and the gaseous hydrocarbon and tar plus carbon yields is correlated with the carbon-hydrogen ratio of oils, the partial pressure of the oil gas in the cracking zone and the relative quantities of base gas, hydrogen and oil introduced into the cracking zone are presented. Methods for estimating the C/H ratio from various groups of simple physical tests are discussed and procedures for estimating the other operating variables from steam data for carburetted water gas and high Btu oil gas manufacture are given. Originally developed for a cracking temperature of 1550°F and 2.5 seconds contact time, these correlations appear to be applicable with reasonable accuracy over the temperature and contact time range used in the manufacture of carburetted water gas (non-reforming) and high Btu oil gas. The correlations are presented in nomographic form to simplify their use. The variables affecting the absorption or production of hydrogen in oil gasification are evaluated and the existence of pseudo-equilibrium between hydrogen, paraffins and unsaturates in the make gas in the hydrogen-production range is demonstrated. From additional data on hydrocarbon pyrolysis a mechanism of high-temperature, vapor-phase cracking is developed.

Author's abstract

Linden, H. R. THE RELATIONSHIP OF PHYSICAL PROPERTIES AND ULTIMATE ANALYSIS FOR LIQUID HYDROCARBONS. *Oil Gas J.* **48**, 60-62, 65 (1949) *July* 7.

A new function of ASTM aniline point, volumetric average boiling point, and API gravity is shown to correlate with the carbon-hydrogen weight ratio of most types of pure liquid hydrocarbons, binary mixtures of such hydrocarbons, and petroleum fractions. The accuracy of C/H ratios estimated by this method is equivalent to that obtained with the correlation of UOP characterization factor and percentage hydrogen when applied to petroleum fractions, namely ± 0.1 C/H ratio. It is further shown that the ASTM aniline point is a simple function of the API gravity and the mean average boiling point for petroleum fractions of nearly constant distillation slope, with the mean average boiling point defined as a function of the volumetric average boiling point and the distillation slope. Finally, the kinematic viscosity and gravity of petroleum fractions is correlated with the mean average boiling point thereby permitting the derivation of empirical equations expressing the relationship of the C/H ratio of petroleum fractions and three different groups of key physical properties, namely; (1) API gravity, 50% boiling point and aniline point; (2) API gravity, 50% boiling point and distillation slope; and (3) API gravity and kinematic viscosity. These equations are presented in nomographic form to simplify the prediction of C/H ratios for pure hydrocarbons and petroleum fractions from the most suitable of the standard physical tests.

Author's abstract

Peak Load

NEW AUTOTHERMIC PEAK GAS PROCESS. *Gas Age* **103**, 24 (1949) *June* 23.

A brief, rather incomplete description is given of a UOP process which amounts to partial combustion of light hydrocarbons with air, using the heat liberated to effect pyrolysis of the remainder of the feed. The reactant mixture contains no steam, and no external heat is necessary. The self-sustaining process can produce ethylene from ethane for the petrochemical industry and reformed gas for the gas industry from the lighter hydrocarbons. Extensive heat exchange gives the high over-all thermal efficiency of 98%. Although the flexibility of the process is pointed out, no mention is made as to the actual extent of interchangeability of the final gas with manufactured gases. No mention is made of reformed gas gravity nor N_2 content under conditions of air ratio necessary to minimize tar, carbon, and naphthalene troubles. No operating temperatures are given.

P. C. Lurie

Purification

Mitchell, J. (assigned to Koppers Co., Inc.) GAS PURIFICATION PROCESS. U.S. 2,464,-824 (1949) March 22.

This invention relates to a process for the separation and recovery of H_2S by scrubbing coke oven gas with aqueous absorbent and actifying the absorbent for further scrubbing by heating it under subatmospheric pressure utilizing heat recovered from quenching the by-product coke.

H. Hakewill

Water Gas Generator

MacGregor, F. A. (assigned to Humphreys & Glasgow Ltd.) STACK VALVE OF WATER GAS GENERATORS AND THE LIKE. U.S. 2,474,111 (1949) July 21.

A stack valve for water gas generators is proposed, which is carried laterally away from the stack by wheels running on tracks. The axle on which the wheels are mounted forms a pivot for a bell-crank, the short arm of which ends in rollers which engage cam-paths formed by weighted levers, and the long arm of which carries the valve pivotally supported near the crank and also is linked to a second bell crank. The motion through about 60 degrees of the second crank causes the forward and downward motion of the valve-carrying crank whereby the wheels roll forward to slide the valve to its seat on the stack. A modification is shown in which a straight bar is substituted for the wheel-supported bell crank.

O. P. Brysch

The following article, the abstract for which appears on the page indicated, is also called to your attention:

Strickland-Constable, R. F. THE SYNTHESIS OF METHANE FROM CARBON MONOXIDE AND HYDROGEN ON A NICKEL CATALYST. p. 191.

5. NATURAL GAS AND NATURAL GAS CONDENSATES

Bureau of Mines

Cattell, R. A. and others. REPORT OF PETROLEUM AND NATURAL GAS DIVISION FISCAL YEAR 1946. U.S. Bureau of Mines Information Circular 7506 (1949) June.

The achievements of the Petroleum and Natural Gas Division of the U.S. Bureau of Mines in research during the fiscal year of 1946 are briefly reviewed. Many interesting and important topics are covered.

J. D. Parent

Compressors

Edmister, W. C. and McGarry, R. J. GAS COMPRESSOR DESIGN. *Chem. Eng. Progress* 45, 421-434 (1949) *July.*

The authors have provided a set of charts and tables for the calculation of the temperature rise and work required for frictionless, adiabatic compression. The method is simpler than that of York [*Ind. Eng. Chem.* 34, 535 (1942)] although admittedly less accurate. It is good to $\pm 5\%$.

J. D. Parent

Abstractor's Note: This is an excellent contribution for the problem presented, but it would be well to have such a procedure for the polytropic case also, since this corresponds more closely to actual operation.

Pryor, C. C. BUILD WORLD'S BIGGEST CENTRIFUGAL COMPRESSOR. *Petroleum Refiner* 28, 131-132 (1949) *June.*

The largest installation of centrifugal compressors in the world will be made at the Carthage Hydrocol Inc. plant at Brownsville, Texas. 24 units totaling more than 80,000 hp are being built by the Clark Bros. Company. Most of the compressors will be used in the oxygen plant.

O. T. Bloomer

NEW COMPRESSOR PLANT FOR LONG BEACH CALIFORNIA GAS SYSTEM. *Compressed Air* 54, 176-177 (1949) July.

The Long Beach system operates its distribution system at 30 psi in feeder mains and 6 psi in distributor mains. It provides for storage of 2 MMcf of gas at high pressure and 17.5 MMcf at 8 to 14 inches of water. A new station houses 4 cycle, gas engine driven, Ingersoll-Rand compressors for compressing gas from the low pressure holder to 15 to 30 psi. Water from the gas holders serves as engine jacket cooling water. Instead of using clearance pockets and/or valve lifters that act automatically, the cylinders were built with considerable clearance; engine speed can be varied 50%.

J. D. Parent

Deodorization

Powell, J. S. EXPERIENCE WITH ODOR AND DEODORIZATION OF MID-CONTINENT NATURAL GAS. *Petroleum Engr.* 21C, *Reference Annual* 30, 33-34, 36, 38-39 (1949).

The Southern California Gas Company experienced a sharp increase in leak complaints due to the change of odor caused by shifting from the distribution of California natural gas odorized with sulfide-disulfide type material to the distribution of Permian basin gas containing substantial concentrations of mercaptans. Most of the leaks reported were traced to gas discharged from burners prior to ignition and to small leaks involving no hazard. The complaints about odor were attributed to the fact that California gas contained less than 0.3 grain H_2S per 100 cu ft and no mercaptans, while Permian basin gas contained less than 0.25 grain H_2S and 0.5 to 1.0 grain mercaptan sulfur per 100 cu ft after treatment in glycolamine and gasoline absorption plants. It was found that mercaptan concentration could be controlled by injecting air into the pipeline. To convert completely from mercaptan to disulfide, 40 cu ft of air were required per MMcf of gas per grain of mercaptan sulfur. At first this conversion occurred in 100 miles of pipe, but after several months the addition of air was no longer effective and it was concluded that an active form of iron oxide on the pipe wall was needed to catalyze the oxidation of mercaptans to disulfide form. A plant process for converting mercaptans to disulfides using iron or cobalt oxide on pumice at ambient temperatures and reactivating the oxide with a mixture of air and steam at 400°F is being developed. The adsorption of mercaptans with activated charcoal and silica gel is also being investigated.

H. Hakewill

Ethane Recovery

Heitz, R. G., Oldershaw, C. F., Brown, W. E. and Barnard, R. D. PILOT PLANTS: LOW TEMPERATURE RECOVERY OF ETHANE FROM NATURAL GAS. *Ind. Eng. Chem.* 41, 1540-1543 (1949) *July.*

The Joule-Thomson effect was applied on a pilot plant scale to the separation of 99% pure ethane from a natural gas stream containing only 2.8% ethane. This paper deals chiefly with the problems encountered in the plant operation such as water and carbon dioxide removal, steady operation of the expansion tubing, and measurement of liquid level. Water removal was accomplished by freezing, passing over alumina gel, and passing over calcium carbide. Carbon dioxide was removed by scrubbing with potassium hydroxide in a column of special design. Glycerol lubrication of the compressor prevented plugging of the expansion tubing. The level of liquid at low temperature was determined by means of a hot-wire electrical meter, which is described. A description of a laboratory-sized methane unit to provide refrigeration at —160°C is presented.

Authors' abstract

Reviewer's Note: Cooling by throttling, or Joule-Thomson expansion, has been extensively used for air liquefaction for many years. The process is attractive for small scale operations, but may not be for larger scale operation unless gas is available under high pressure.

J. D. Parent

Leakage Tracer

Wilby, F. V. ACETYLENE AS A NATURAL GAS LEAKAGE TRACER. *Gas Age* **104**, 32-34, 64 (1949) *July* 7.

Quick, simple, certain location of gas leaks from mains is a problem of major importance. The combustible gas indicator is of great value, but its value is sometimes reduced by the complex nature of the leak. Introduction of a unique substance, such as acetylene or helium as a tracer in natural gas mains is recommended as a solution in this case. Properties desirable in a tracer, such as ease of detection and freedom from interference with gas usage, are listed. Acetylene can be detected as silver acetylide.

J. D. Parent

LP-Gas

IT TAKES A LOT OF GAS TO DRILL FOR OIL. *Butane Propane News* **11**, 119-121, 123-124, 127 (1949) *July*.

The use of LP-gas for the generation of power for drilling rigs is recommended.

J. D. Parent

Natural Gasoline

TXL GASOLINE PLANT EXCEEDS ORIGINAL DESIGN CAPACITY. *Petroleum Refiner* 28, 150 (1949) *June*.

The TXL gasoline plant near Odessa, Texas is presently processing 50 MMcf per day of casinghead gas, exceeding the design capacity of 30 MMcf. The products are natural gasoline, liquefied petroleum gas, and propane. The stripped gas is returned to the leases for repressuring and other operations. Design features of the plant are briefly discussed.

O. T. Bloomer

Nitrogen Removal

Wade, H. N. REMOVAL OF NITROGEN FROM NATURAL GAS. *Oil Gas J.* 48, 195-196, 198-200 (1949) *June* 23.

The advantages of nitrogen removal from natural gas and the processes proposed for achieving this are reviewed. Low temperature fractionation is favored due to ease of recovery of LP-gas. Removal of LP-gas lowers the heating value but this is offset by the nitrogen removal. A minor advantage is the decrease in specific gravity which decreases the compressor power requirements.

J. D. Parent

Pipe Line Coatings

Day, S. D. DEVELOPMENT OF PIPE LINE COATINGS AND MECHANICAL APPLICATION METHODS. *Corrosion* 5, 221-226 (1949) *July*.

A brief history of the development of pipe line coatings and the results of coating tests conducted by the oil industry, coating manufacturers, and the A.P.I. in the early 30's are given. From these tests four materials: (1) coal tar enamel; (2) asphalt; (3) petroleum compounds or greases; and (4) bituminous mastics were found to be satisfactory.

B. E. Hunt

Scherer, L. F. and Mudd, O. C. MECHANICAL ASPECTS OF PIPE LINE COATINGS. *Petroleum Engr.* **21D**, *Reference Annual*, 27-28, 30-32, 34 (1949).

The cost of coating materials and their application has become an important factor in the cost of a new line. The economical practice is to apply a reasonably stable coating and then compensate for its imperfections with cathodic protection. A brief resumé of the coating materials tested by the API in 1930-1940 and the results obtained is given. Coating reinforcement with glass fiber and asbestos felt is now practiced. Proper trench preparation and pipe cleaning prior to coating are stressed. A specimen specification for the application of a protective coating to a pipeline is given.

B. E. Hunt

Production

Calhoun, J. C., Jr., Lewis, M., Jr., and Newman, R. C. EXPERIMENTS ON THE CAPILLARY PROPERTIES OF POROUS SOLIDS. *Petroleum Technol.* 1, *Trans. Section*, 189-196 (1949) *July*.

Experimental work is reported for lowering of water vapor pressure within a porous solid and

relation of such data to capillary pressure values. The practical object is to evaluate connate water in cores by means of capillary pressure curves. Good agreement between capillary pressure data obtained by displacement and that calculated from vapor pressure data was obtained.

J. D. Parent

Caruthers, C. B. PROCEDURES, BENEFITS, AND PROBLEMS OF UNITIZATION. *Petroleum Engr.* **21A**, *Reference Annual* 86-88, 90-91 (1949).

The problem of unitization is analyzed. Types of unitization, unitization procedures, state regulations, benefits and problems encountered are related.

J. D. Parent

Clark, J. B. HYDRAFRAC PROCESS FOR INCREASING THE PRODUCTIVITY OF WELLS. *Petroleum Engr.* **21B**, *Reference Annual* 3, 7-12 (1949).

The hydrafac, or hydraulic pressure fracturing method, of increasing well productivity is discussed. Requirements of the fluids and method of usage are stated.

J. D. Parent

Doscher, T. M. CHARACTERISTICS OF DETERGENT SUSPENDED DRILLING FLUIDS. *Oil Gas J.* **48**, 75-76, 79-80 (1949) *June* 30.

A study of the effect of additives on suspensions of bentonite in water is reported. It is a general study of the formulation of drilling fluids.

J. D. Parent

Eilerts, C. R., Smith, R. V., Archer, F. G., Burman, L. M., Greene, F. and Hamontre, H. C. FIELD AND LABORATORY TESTS OF SODIUM CHROMATES AND ALKALIES FOR CONTROLLING CORROSION IN GAS CONDENSATE WELLS. PART I. THE PROBLEM AND A RESUME OF RESULTS OBTAINED. *World Oil* **129**, 142-144, 146, 148, 150 (1949) *July*.

Field tests in two gas condensate fields indicate that corrosion protection by the use of sodium chromate and alkalies would add less than $1.00 to the cost of producing 1 MMcf of gas. A procedure is outlined for adapting chromate treatment to individual wells. The experimental program, extent of corrosion protection, equipment used, and the composition and phase of the flowing fluid are described.

B. E. Hunt

Fearon, R. E. NEUTRON WELL LOGGING. *Nucleonics* **4**, 30-42 (1949) *June*.

Neutron well logging is a method of scanning the exposed strata in a borehole. A source of neutrons and a detector of ionizing radiation are passed successively through the borehole, and the curve derived is a record of the intensity of the secondary ionizing radiation plotted versus depth. The apparatus and theory of neutron well logging are discussed. The sampling secured by this method is very extensive. Neutron and gamma ray curves are usually analyzed together and augment each other.

O. T. Bloomer

Harwick, R. CASING CHECKS OBTAINED WITH DEEP-TUBE CAMERA. *Oil Gas J.* **48**, 88-89, 109 (1949) *July* 14.

A camera has been developed to photograph the inside of casing in dry wells or under clear water. Pictures are shown to illustrate its usefulness in locating such defects as bulges due to stress.

J. D. Parent

Horner, V. and Kimbrell, W. B. MUD CONTROL AND DESIGN. *Petroleum Engr.* **21B**, *Reference Annual* 68, 70, 72, 74, 78 (1949).

The most effective use of drilling mud requires control of density, viscosity and filtration characteristics. Practical methods of controlling such properties are related.

J. D. Parent

Lyon, L. R., Feagan, R. A., Jr. and Manley, H. B. ELK BASIN PLANT A CONSERVATION PROJECT. *Oil Gas J.* **48**, 70-73, 87-89 (1949) *June* 30.

All interests in the Embar-Tensleep and lower oil sands were unitized for a pressure maintenance project. The plant processes 12 MMcf/day of casinghead gas. The plant is unusual in

some aspects. Insofar as the gas which could be returned was inadequate and water was insufficient, the plant was designed to produce and inject 14 MMcf/day of flue gas. Casinghead gas contains 2% N_2, 6% CO_2 and 18.5% H_2S. The H_2S and CO_2 are removed by the amine process, but instead of flaring or venting the H_2S it is recovered as elemental sulfur.

J. D. Parent

Williams, N. WORLAND FIELD DEVELOPMENT. *Oil Gas J.* **48**, 75, 77-78, 80 (1949) *July* 14.

Problems in the development of the Worland Oil field in Wyoming are discussed. The gas associated with the oil contains approximately 38% hydrogen sulfide. Various safety devices to prevent escape of the poisonous gases at the field separators and tank batteries are described. Currently the gas is being vented and burned without processing, but construction is under way on a sulfur extraction plant and a gasoline plant. Severe hydrate forming conditions develop in the producing string because of the temperature drop with the reduction in pressure and it is necessary to heat the inside of the wells. This is done by circulating hot oil through an auxiliary string of 5 in. pipe to a depth of 3500 ft. The completion procedure for the wells is also described.

O. T. Bloomer

BACK PRESSURE TEST FOR NATURAL GAS WELLS. Austin, Texas, Railroad Commission of Texas. 1949.

The literature on the back pressure method of deliverability evaluation is reviewed and a procedure for making the test is prescribed. All items are clearly explained and many illustrative calculations are given. Data required for calculation are provided in tabular form.

J. D. Parent

Storage

Ball, M. W. and Vary, J. A. UNDERGROUND GAS STORAGE. *Gas Age* **103**, 15-20, 43, 45-46 (1949) *June* 23.

Significant economic and geological factors in underground storage are presented. A great deal of available information on storage fields has been tabulated, but data are incomplete particularly as to required permeability or open flow deliverability. Investment costs exclusive of compressor stations, dehydration equipment and connecting pipe lines range from 2 to 53¢ per Mcf of usable capacity. Enormous quantities of gas can be stored where fields are available; Manufacturers Light and Heat Company is now storing 59,000 MMcf. Currently 77 fields are in use with a capacity of 437,328 MMcf. Many types of structures are in use.

J. D. Parent

Transmission

Attaway, D. APPROVED PRACTICES FOR REPAIRING GAS PIPE LINES. *Petroleum Engr.* **21D**, 20-22 (1949) *June.*

Methods of repairing high pressure gas pipe lines under pressure are described. Included are repair of coupling leaks, welded joints, weak sections, small pin hole leaks, and side-top leaks. Safe practices in pipe line repair are stressed.

O. T. Bloomer

Mosteller, W. C. THE FLOW EFFICIENCY OF A 30-IN. O.D. NATURAL-GAS TRANSMISSION LINE. *Oil Gas J.* **48**, 81-82, 84, 86 (1949) *July* 7.

See *Gas Abstracts* **5**, 140 (1949) *June* for abstract.

The following article, which has not been abstracted, is called to your attention:

Nelson, W. L. COSTIMATING: COMPRESSORS. Oil Gas J. 48, 223 (1949) June 23.

The following article, the abstract for which appears on the page indicated, is also called to your attention:

Cattell, R. A. and others. REPORT OF PETROLEUM AND NATURAL GAS DIVISION FISCAL YEAR. 1945. p. 189.

6. PETROLEUM AND SYNTHETIC LIQUID FUELS

Bureau of Mines

Cattell, R. A. and others. REPORT OF PETROLEUM AND NATURAL-GAS DIVISION FISCAL YEAR 1945. U.S. Bureau of Mines Information Circular 7505 (1949) June.

This circular reports briefly the activities of the Petroleum and Natural Gas Division of the Bureau of Mines during 1945. Correlations of sandstone and other porous reservoir rocks comprising the producing zones, evaluations of the productivity of wells, determination of the characteristics of fluids from gas-condensate fields and other data pertinent to calculations regarding cycling programs were collected. Studies of internal corrosion in the tubing and well-head fittings of high-pressure, high-temperature gas-condensate wells indicated that sodium chromate will inhibit the corrosive action of dissolved carbon dioxide, phenol and organic acids such as formic, acetic, propionic, butyric and valeric acids which may be present. A high-pressure window cell was designed to study liquid-to-gas ratios at low temperatures and various pressures. The problems of well coring and other production operations were studied. The majority of the Division's work pertained to problems primarily of interest to the petroleum industry.

J. C. Lane

Coal Hydrogenation

Markovits, J. A. COAL HYDROGENATION. *Mech. Eng.* 71, 553-560 (1949) *July.*

Following a brief description of the coal hydrogenation plant at Louisiana, Missouri, the design of various reactors for use at 10,000 psi and 1000°F is discussed. The design of the paste preheater is presented in some detail since radiant heating is employed in distinction to the convection type used in European practice. Two sections are needed in this preheater because of the rapidly changing heat transfer coefficients due to coal swelling at about 600°F and to partial hydrogenation at somewhat higher temperatures. Information concerning heat exchangers, pumps, flanged joints, fittings, valves and other items is presented.

C. H. Riesz

Orchin, M., Goldbach, G. L., Wolak, M. and Storch, H. H. COAL HYDROGENATION. THE EFFECT OF VARIATIONS IN THE COAL-TO-VEHICLE RATIO. U.S. Bureau of Mines Report of Investigations 4499 (1949) July.

Pittsburgh bed coal has been hydrogenated in batch experiments at 1000 psi initial hydrogen pressure and in the presence of tin sulfide-ammonium chloride catalyst. Vehicle (tetralin)-to-coal ratios were varied from 10:1 to as low as 0.6: 1 at various temperature and time conditions. The results indicate that the extent and rate of coal liquefaction is not greatly dependent on the vehicle acting as a hydrogen donor to the coal substance. High pressure hydrogen is apparently essential for extensive liquefaction.

C. H. Riesz

Corrosion

Brannon, R. A. INTERNAL CORROSION OF CRUDE-OIL TANKS. *Petroleum Engr.* 21D, *Reference Annual*, 22-25 (1949).

The roofs and bottoms of tanks containing sour crudes are the most severely attacked portions. The presence of water, settled salt water on the bottom and condensed water on the roof, in combination with sulfur compounds controls the corrosion of the metal. Bituminous coatings, coal tar base coatings, and synthetic plastic coatings are being field tested in sour crude producing fields. The use of aluminum roofing and structural members is economically competitive with steel. Gunite, a reinforced portland cement mortar, appears to be the most effective in preventing corrosion of all portions of tanks of all sizes.

B. E. Hunt

Cracking Catalyst

Grenoll, A. MONTMORILLONITE CRACKING CATALYST. *Ind. Eng. Chem.* **41**, 1485-1489 (1949) *July.*

By means of titration, the presence of hydrogen ion in Filtrol clay cracking catalyst (Montmorillonite) has been established. The concentration of hydrogen ion decreases with increase in the temperature (above 900°F) at which the catalyst is heated in air; the relationship is linear and complete decomposition is predicted at 1561° ± 70°F. This checks the value of 1560°F found by X-ray analysis and of 1562°F found by thermal analysis. The effect of steam treatment is to remove hydrogen ions; it is non-linear, reaching equilibrium values depending upon the temperature and steam concentration. Results are correlated with X-ray diffraction data.

C. H. Riesz

Fischer-Tropsch Synthesis

Barr, F. T. (assigned to Standard Oil Development Co.) HYDROCARBON SYNTHESIS. U.S. 2,475,214 (1949) July 5.

Steam equivalent to a volume varying from 25% to 100% of the carbon monoxide plus hydrogen content of the synthesis gas is added to maintain a superficial gas velocity of from about 1.5 to 3 ft per second in the fluidized catalyst bed.

C. H. Riesz

Clark, A., Andrews, A. and Fleming, H. W. COMPOSITION OF A SYNTHETIC GASOLINE. *Ind. Eng. Chem.* **41**, 1527-1532 (1949) *July.*

Gasoline synthesized from carbon monoxide and hydrogen in the presence of fluidized iron catalyst was percolated through silica gel. Each of eight fractions was separated into paraffins, olefins, aromatics and oxygenated compounds. The C_5, C_6 and C_7 fractions contain 40 to 50% by volume of straight-chain 1-olefins. Aromatics were present in the C_6 to C_{12} fractions, inclusive, the highest percentage, 7.2%, being found in the C_{10} fraction; 15 different aromatic compounds were identified. Small amounts of diolefins appeared to be present in most of the fractions.

C. H. Riesz

Jenny, F. J. and Riblett, E. W. (assigned to Hydrocarbon Research, Inc.) PROCESS FOR SYNTHESIZING HYDROCARBONS. U.S. 2,474,845 (1949) July 5.

In order to counterbalance the volume contraction (50%) caused by the interaction of carbon monoxide and hydrogen to form hydrocarbons and consequent reduction of linear gas velocity in a fluidized catalyst bed, a vaporizable fraction of the liquid hydrocarbon product is recycled into the reactor. The recycled oil also serves to cool and remove the exothermic heat of reaction.

C. H. Riesz

Johnson, E. A. (assigned to Standard Oil Co.) HYDROCARBON SYNTHESIS WITH FLUIDIZED CATALYST REGENERATION. U.S. 2,472,427 (1949) June 7.

In the synthesis of hydrocarbons from carbon monoxide and hydrogen in the presence of fluidized catalyst, a portion of the catalyst is continuously withdrawn and regenerated with hydrogen. Several means of effecting this process are proposed.

C. H. Riesz

Sweetser, S. B. (assigned to Standard Oil Development Co.) PROCESS OF REGENERATING SYNTHESIS CATALYST WITH OXYGEN AND RETURN OF OXIDIZED CATALYST TO THE SYNTHESIS REACTOR. U.S. 2,472,501 (1949) June 7.

In the synthesis of hydrocarbons from carbon monoxide and hydrogen carried out with fluidized iron catalyst, a portion (e.g. 2% of the reactor charge per hr) is continuously withdrawn and is regenerated with oxygen-containing gases. The regenerated iron catalyst is re-entered into the reactor in an oxidized condition.

C. H. Riesz

Methane Synthesis

Strickland-Constable, R. F. THE SYNTHESIS OF METHANE FROM CARBON MONOXIDE AND HYDROGEN ON A NICKEL CATALYST. Gas Research Board Communication GRB 46 (1949) April.

The hydrogenation of carbon monoxide to form methane in the presence of nickel catalyst has been studied. The reaction begins at about 482°F and appears to be between first and zero order with respect to total pressure. Increased carbon monoxide concentration retards the reaction but no retardation is attributed to products. By means of low pressure (0.030 to 0.150 mm of mercury) gas analysis, a material balance of the components in the gaseous phase and in the catalyst substrate was determined at various intervals during a run in the static experimental system. On the basis of the results, a reaction mechanism is proposed which postulates that carbon monoxide is adsorbed as the first step, the carbon being bound to the nickel lattice with oxygen unattached. By interaction with adsorbed hydrogen, oxygen is hydrogenated to water with a possible hydroxyl intermediate while carbon is hydrogenated to methane with a possible methylene intermediate. That the temperature coefficient is low (e.g., 1.6 for a raise in temperature from 572 to 644°F corresponding to an activation energy of 16,200 Btu per pound), is not sufficiently explained by the theory as proposed.

C. H. Riesz

Synthetic Fuels

Golumbic, N. SOME CHEMICALS FROM SYNTHETIC LIQUID FUELS PROCESSES. U.S. Bureau of Mines Report of Investigations 4467 (1949) June.

The production of chemicals from both the primary products as well as the byproducts of the Bergius (hydrogenation of coal) and the Fischer-Tropsch (hydrogenation of carbon monoxide) processes are reviewed and discussed.

C. H. Riesz

The following articles, the abstracts for which appear on the pages indicated, are also called to your attention:

Evans, G. E. GAS ENRICHMENT OIL. p. 182.
Linden, H. R. METHODS OF ESTIMATING OIL GASIFICATION YIELDS. p. 183.

Linden, H. R. THE RELATIONSHIP OF PHYSICAL PROPERTIES AND ULTIMATE ANALYSIS FOR LIQUID HYDROCARBONS. p. 183.

7. ANALYTICAL METHODS AND TESTS

Fractionation

Dixon, O. G. HIGH EFFICIENCY LABORATORY FRACTIONATION. II. GLASS LABORATORY STILLS. *J. Soc. Chem. Ind.* (British) 68, 119-121 (1949) *April.*

Two glass fractionating columns for precise laboratory work are described. They have boilers of capacity 200 ml and 1 liter respectively. Both are capable of fractionating material of boiling point up to 300°C at atmospheric or reduced pressure. The boiler and column in each case are surrounded by oil jackets which prevent heat losses from the system. Boilers and jackets are electrically heated. Gauze ring packing, fully described in a previous paper, is used together with a device which enables the packing to be flooded and it is to these features that the high efficiency of the fractionating columns is ascribed. In a previous paper the development and use of gauze ring packing for high efficiency fractionation was described and the importance of proper preflooding was emphasized. This paper described fractionating apparatus which is easily controlled, in which the operating conditions have been determined, and where gauze ring packing may be used to its full advantage.

Author's abstract

French, K. H. V. AUTOMATIC SMALL-SCALE SUPER-FRACTIONATION. *Gas World* (British) 130, *"Supplement"* 65-72 (1949) *June* 4.

This paper gives the details of a fully automatic fractionation assembly. The fractionating section consists of a glass tube 39 in. long and ¾ in. diameter packed with 1/16 in. diameter gauze ring-packing. The boil-up rate is controlled by electric contacts in a manometer actuated by column pressure. The take-off is intermittent and controlled by a clock which at intervals operates a control which allows nitrogen to displace liquid trapped in the still head. Air thermometers on column and jacket insure substantially adiabatic conditions by actuating a manometer with electric contacts. Still head temperatures are measured with a resistance thermometer. The still pressure is controlled by electric contacts in a manometer. A bottle changer feeds the distillate into a fresh bottle every two hours. The apparatus is equipped with safety devices which shut down the entire assembly in case of failure of power or water supply. With this column it has been possible to obtain a fraction consisting of 87% thiophene from crude benzol.

W. E. Ball

Miller, A. J. PROGRESS REPORT ON LOW TEMPERATURE FRACTIONAL ANALYSIS PROJECT FOR LIQUID HYDROCARBONS. *Petroleum Engr.* 21C, Reference Annual 40, 42-44 (1949).

The program undertaken by the NGAA to evaluate and improve the accuracy of low temperature fractional analysis is described. A synthetic mixture comprised of 32.19 mol % propane, 15.81 mol % iso-butane, 48.99 mol % n-butane, 2.77 mol % iso-pentane, and 0.24 mol % n-pentane was distributed to 58 participating laboratories; the results obtained were correlated and plotted to demonstrate the accuracy and the deviation from the mean achieved. The average deviation from the synthesis composition for the individual components were: propane 1.21 mol %; iso-butane 0.90 mol %; n-butane 1.48 mol %; and iso-pentane 0.55 mol %. The effects of the size of sample taken, the time required to run the sample, and the size of gas measurement bottles on the average deviation were also plotted. As in the past gas analysis program, it was concluded that exact equipment standardization is not as important as the human element determining the cleanliness and general condition of equipment and the attention to correct calibration and readings.

H. Hakewill

Mass Spectrometer

Hunter, J. A., Stacy, R. W. and Hitchcock, F. A. A MASS SPECTROMETER FOR CONTINUOUS GAS ANALYSIS. *Rev. Sci. Instruments* 20, 333-336 (1949) *May.*

An instrument is described for the continuous analysis of three-component gas systems. The use of a mass spectrometer to separate the gaseous components renders the individual analyses independent of the concentrations of the other members. A speed of response of 0.3 seconds makes the instrument of value in following transient phenomena. An accuracy of 1 mm partial pressure is claimed for the instrument.

S. Katz

Spectroscopy

Foreman, R. W. and Jackson, W., Jr. A RAPID AUTOMATIC METHOD OF COMPUTING INFRARED SPECTRA FOR QUANTITATIVE ANALYSES. *Instruments* 22, 497-499 (1949) *June.*

A simple instrument which permits the direct recording of per cent transmission of infrared spectra is described. Designed for a single beam type of recording spectrophotometer, a saving of 4-5 man hrs computing time per sample, and an accuracy of ±0.5% transmission was noted.

D. V. Kniebes

Thermal Conductivity Cell

Clark, W. J. (assigned to Imperial Chemical Industries Ltd.) THERMAL CONDUCTIVITY ANALYSIS OF GASES. U.S. 2,472,645 (1949) June 7.

A thermal conductivity cell is described, suitable for the analysis of gaseous mixtures. A

device to compensate for pressure fluctuations at subatmospheric pressures forms a part of the systems. No reference is made to the number of components which may be analyzed.

S. Katz

Hood, C. B., Jr., Jones, W. and Johnston, H. L. (assigned to United States of America as represented by the United States Atomic Energy Commission). DEVICE FOR MEASURING THERMAL CONDUCTIVITY. U.S. 2,475,138 (1949) July 5.

Ten apparatus claims are granted for the measurement of the thermal conductivity of liquids and gases by the spherical method, the equipment for which comprises an outer spherical shell of a highly conductive metal such as copper, an inner spherical ball also of a highly conductive material such as copper, means for suspending the inner spherical ball so that it is substantially concentric with the outer spherical shell, means for heating the inner spherical ball and measuring its temperature, means for controlling the temperature of the outer spherical shell such as by immersion in a boiling liquid bath and means for introducing to the system the liquid or gas to be measured. The thermal conductivity of the material introduced in the annular zone between the spherical ball and spherical shell is calculated from Fourier's law knowing the time rate of heat input, temperature difference between the spherical ball and spherical shell and the dimensions of the apparatus.

C. Von Fredersdorff

The following articles, the abstracts for which appear on the pages indicated, are also called to your attention:

Blake, P. D. COMPARISON OF METHODS FOR DETERMINING SURFACE AREA AND OTHER PARTICLE SIZE DATA OF FINE POWDERS. . . p. 194.

Keillor, R. D. A PROPOSED NEW CALORIMETER. p. 179.

8. GENERAL AND PHYSICAL CHEMISTRY

Activated Charcoal

Juhola, A. J. and Wiig, E. O. PORE STRUCTURE IN ACTIVATED CHARCOAL. I. DETERMINATION OF MICRO-PORE SIZE DISTRIBUTION. *J. Am. Chem. Soc.* **71**, 2069-2077 (1949) *June.*

Micro pore size distribution for two activated and one unactivated charcoal was calculated from the water displacement and nitrogen surface area data using the Kelvin equation. These values were compared with the experimental results. Water adsorption on the unactivated charcoal was monolayer surface adsorption type while for the activated it was due to the adsorption in the pores. Results on the pore structure data in the activated charcoal are in agreement with the construction hypothesis of McBain.

S. Mori

Juhola, A. J. and Wiig, E. O. PORE STRUCTURE IN ACTIVATED CHARCOAL. II. DETERMINATION OF MACRO PORE SIZE DISTRIBUTION. *J. Am. Chem. Soc.* **71**, 2078-2080 (1949) *June.*

Pore size distribution between diameters of 1,200 to 160,000 A° in charcoal is obtained using mercury displacement under different pressures. The pore sizes are calculated from the capillary rise equation. The apparatus is described in detail. Still lacking is an accurate method for determining the contact angle of mercury with charcoal. This value is necessary for precise pore structure studies.

S. Mori

Adsorption

Smith, W. R. and Beebe, R. A. HEATS OF ADSORPTION AND RELATIVE ADSORBABILITY OF SOME GASEOUS HYDROCARBONS. *Ind. Eng. Chem.* **41**, 1431-1435 (1949) July.

It is demonstrated that 1-butene is selectively adsorbed by silica gel from a vapor state mix-

ture of 1-butene and butane, while no evidence of the separation of 1-butene from butane over carbon black or of propene from butane over silica gel is found. Calorimetric measurements of the heats of adsorption of 1-butene and butane on silica gel indicate that the heat of 1-butene exceeds that of butane by 3 kg. cal per mol of initially adsorbed mono layer. Very little differences were found in the heats of adsorption of 1-butene and butane on carbon black and of propene and butane on silica gel.

B. E. Hunt

Corrosion

Dravnieks, A. and McDonald, H. J. HIGH TEMPERATURE CORROSION OF METALS. *Corrosion* 5, 227-233 (1949) *July.*

This paper deals with the high temperature corrosion of metals and general theories concerning it. The various growth laws, parabolic, logarithmic, and asymptotic, are discussed with the majority of the emphasis on the parabolic law. Diffusion of either gas or metal through the scale is thought to be a deciding factor. The electro-chemical theory of scale growth and the disorder theory of diffusion in solids are proposed explanations. The various factors, such as temperature, pressure, rate of gas flow, gas phase diluents, compound metal systems, metal surface, and variation of temperature, are described briefly.

B. E. Hunt

Gulbransen, E. A. KINETIC AND STRUCTURAL FACTORS INVOLVED IN OXIDATION OF METALS. *Ind. Eng. Chem.* 41, 1385-1391 (1949) *July.*

A study is reported of the kinetics and of the structural factors involved in the high temperature (500°C) oxidation of metals. The effect of time, temperature, and pressure upon the oxidation rate of molybdenum, iron, tungsten, aluminum, and magnesium are shown. The structural factors were studied with the aid of the electron micrograph and electron diffraction reflection patterns. A correlation was attempted between experimental data and oxidation theory.

B. E. Hunt

Hackerman, N. and Schmidt, H.R. THE ROLE OF ADSORPTION FROM SOLUTION IN CORROSION INHIBITOR ACTION. *Corrosion* 5, 237-243 (1949) *July.*

The authors attempt an explanation of the role of adsorption from solution in corrosion inhibitor action. The function of the inhibitor molecule after adsorption is the main point of variance among investigators. A general theory involving both chemisorption and physical adsorption is developed and experimental evidence is given.

B. E. Hunt

Particle Size

Blake, P. D. COMPARISON OF METHODS FOR DETERMINING SURFACE AREA AND OTHER PARTICLE SIZE DATA OF FINE POWDERS, PARTICULARLY WELDING ELECTRODE POWDERS. *J. Soc. Chem. Ind.* (British) 68, 138-148 (1949) *May.*

This paper describes the hydrometer method of particle size determinations in the subsieve range, and discusses a number of methods of making surface area determinations. One method, due to Heywood, employs much precise microscopic and computational work. Two methods by Roller employ the fundamental law of particle size distribution,

$$y = a\, x^{1/2}\, e^{-b/x}$$

where y is the weight per cent of all materials less than x microns in diameter, and a and b are constants for the powder. The three methods are illustrated with extensive tabulations of data and calculations. An evaluation of each method is included.

S. Katz

Radio-isotopes

Seligman, H. APPLICATION OF RADIO-ISOTOPES IN INDUSTRY. *Chem. & Ind.* (British) 1949, 311-316 (*May*

The field of application of radio-isotopes to industrial problems is very large and is, as yet, relatively unexplored. The principal source of radio-isotopes is the pile, which has, up to the present, made available about 100 useful spe-

cies. The calculation of specific activity of an irradiated substance may be made employing a simple relationship between the pile neutron flux and the properties of the isotope. Radio-isotopes find their chief uses in industry because of their ionizing powers, the penetrating power of their radiations and the ease of detection of disintegrations. Radio-isotopes have been used to eliminate static electricity, to stabilize spark discharges, as dust precipitators and in radio tubes. The design of a liquid level indicator is described, and a number of indicating devices such as balance and galvanometer scales. The continuous measurement of films, thickness, and of fluid flow in pipe lines, and the detection of sulfur in rubber, coke, and iron are other possibilities. Tracers have been used to study petroleum formations, lubrication processes, and metal wear. Sulfur and carbon tracers may be applied to many industries. Health hazards must receive careful consideration in any program of radio-isotope work.

S. Katz

Temperature Scale

Stimson, H. F. THE INTERNATIONAL TEMPERATURE SCALE OF 1948. *J. Research Natl. Bur. Standards* 42, 209-217 (1949) *June* 23.

The author describes the first revision of the International Temperature Scale since its adoption in 1927. The principal differences are a revised value for the temperature of the silver point, and the adoption of the Planck radiation formula to define very high temperatures. The six fixed points are defined and interpolation formulae are given. Twenty-one secondary fixed points are also described. The replacement of "Centigrade" with "Celsius" is recommended. The freezing point of water is best determined as a function of the triple point. The probable value of 0°C is given as 273.15°K.

S. Katz

Thermodynamics

Binder, J. L. THERMODYNAMIC FUNCTIONS OF CH_3SH AND $(CH_3)_2S$. *J. Chem. Phys.* 17, 499-500 (1949) *May.*

The entropies, free energies, heat capacities, and heat contents for methyl mercaptan and for dimethyl sulfide were calculated by statistical methods over the temperature range 298° to 1500°K.

H. Hakewill

Edmister, W. C. APPLICATION OF THERMODYNAMICS TO HYDROCARBON PROCESSING. PART XX. VAPOR-LIQUID EQUILIBRIUM IN NON-IDEAL SYSTEMS. *Petroleum Refiner* 28, 143-148 (1949) *June.*

The discussion of vapor-liquid equilibrium in ideal systems begun in the previous installment has been extended to include non-ideal systems. For greatest generality, the case where both liquid and vapor phase are not ideal is selected. The vapor-liquid equilibrium ratios are usually calculated from PVT data or experimental data, or combinations of these two methods. The resulting ratios may then be correlated, and correction factors may be derived which allow for the pressure, temperature and composition variables. A method of determining the vapor and liquid fugacities separately is outlined.

S. Katz

Giauque, W. F. and Gordon, J. THE ENTROPY OF ETHYLENE OXIDE. HEAT CAPACITY FROM 14 TO 285°K. VAPOR PRESSURE. HEATS OF FUSION AND VAPORIZATION. *J. Am. Chem. Soc.* 71, 2176-2181 (1949) *June.*

The heat capacity of solid and liquid ethylene oxide, heat of fusion and the melting and boiling points have been determined. Calorimetric measurements have been used to determine the entropy of the ideal gas at the boiling point. Of interest is the detailed description of the procedure followed in these determinations.

S. Katz

Katz, L., Woods, L. B. and Leverton, W. F. THE RESONANCE METHOD OF MEASURING THE RATIO OF THE SPECIFIC HEATS OF A GAS C_p/C_v[1]. PART V. Section A: AN IMPROVED APPARATUS FOR MEASURING THE RATIO OF THE SPECIFIC HEATS OF A GAS. Section B: THE USE OF ELECTRONIC COUNTER CIRCUITS TO MEASURE LOW FREQUENCIES AND A VARIABLE LOW FREQUENCY OSCILLATOR. *Can. J. Research* **27A**, 27-38 (1949) *May.*

Section A of this paper describes an improved apparatus for determining the ratio of the specific heats of gases (C_p/C_v). The device consists of a cylindrical gas chamber separated by a diaphragm whose resonant frequency serves to define the desired quantity. The device may be used for corrosive gases and over a wide temperature and pressure range. Section B of the paper describes the circuits of an electronic frequency meter and interval timer for use with the apparatus.

S. Katz

Katz, L., Leverton, W. F. and Woods, S. B. THE RESONANCE METHOD OF MEASURING THE RATIO OF THE SPECIFIC HEATS OF A GAS C_p/C_v[1]. PART VI. CARBON DIOXIDE, NITROUS OXIDE AND METHANE. *Can. J. Research* **27A**, 39-44 (1949) *May.*

The resonance method of measuring the ratio of specific heats has been used in determinations on carbon dioxide, nitrous oxide and methane over a range of pressures. Extrapolation to zero pressure gives values in very good agreement with spectroscopic data. A thermodynamic analysis of the effect of impurities is included.

S. Katz

Kilpatrick, J. E., Beckett, C. W., Prosen, E. J., Pitzer, K. S. and Rossini, F. D. HEATS, EQUILIBRIUM CONSTANTS, AND FREE ENERGIES OF FORMATION OF THE C_3 TO C_5 DIOLEFINS, STYRENE, AND THE METHYLSTYRENES. *J. Research Natl. Bur. Standards* **42**, 225-240 (1949) *March.*

The heat content function, free energy function, entropy, heat capacity, heat of formation and free energy of formation have been determined for 100°K intervals in the temperature range between 0°K and 1500°K for the C_3 to C_5 diolefins, styrene and the methyl-styrenes. The equilibrium concentrations of the two butadienes, seven pentadienes and six methylstyrenes are also given.

S. Katz

Viscosities

Buddenberg, J. W. and Wilke, C. B. CALCULATION OF GAS MIXTURE VISCOSITIES. *Ind. Eng. Chem.* **41**, 1345-1347 (1949) *July.*

Gas mixture viscosities do not follow any simple additive relation. Many equations have been derived, but they are quite complex. Sutherland presented a relation for a binary mixture involving two constants, which is quite satisfactory. Schudel later interrelated the two constands by means of the densities of the pure components so that only one is required. This equation has been checked by the authors and found to be very satisfactory with the exception that it requires experimental evaluation. They then showed the constant to be inversely related to the diffusion coefficient. The authors have suggested a general form for multi-component systems which they closely checked for several ternary and quaternary systems.

J. D. Parent

The following article, the abstract for which appears on the page indicated, is also called to your attention:

Marschner, R. F. and Cropper, W. F. HYDROCARBON AZEOTROPES OF TOLUENE. p. 197.

10. CHEMICAL ENGINEERING

Azeotropes

Marschner, R. F. and Cropper, W. F. HYDROCARBON AZEOTROPES OF TOLUENE. *Ind. Eng. Chem.* **41**, 1357-1362 (1949) *July.*

Efficient fractionation of petroleum toluene concentrates revealed the presence of a series of toluol-lean azeotropes of saturated hydrocarbons. The composition of the interfering saturated compounds was confirmed by the testing of synthetic samples made up of toluene and the pure hydrocarbons. The azeotropic properties of the six mixtures were readily correlated as to boiling point of saturated hydrocarbon, boiling point of azeotrope and composition, enabling the prediction of the properties of unknown toluene azeotropes. The correlations show that toluene forms azeotropes through an 18°C boiling range, compared to 30° in the case of benzene.

W. E. Ball

Fluid-Solid System Symposium

The following papers were presented at the fifteenth annual chemical engineering symposium, DYNAMICS OF FLUID-SOLID SYSTEMS, held by the Division of Industrial and Engineering Chemistry of the American Chemical Society at the Massachusetts Institute of Technology, Cambridge, Massachusetts, December 28-29, 1948.

Beck, R. A. EVALUATION OF FLUID CATALYST. *Ind. Eng. Chem.* **41**, 1242-1243 (1949) *June.*

In order to evaluate fluidized catalysts in 0.5 in. and 0.75 in. tubes, two methods were devised to break up slugs, that is, piston flow of solids; one method used a rotating helically-finned rod, while the other depended on the use of propellor type baffles spaced at 4 in. intervals.

W. J. Merwin

Belden, D. H. and Kassel, L. S. PRESSURE DROPS. *Ind. Eng. Chem.* **41**, 1174-1178 (1949) *June.*

Pressure drop measurements were taken when vertically transporting spherical catalyst particles 0.04 to 0.08 inch diameter. A correlation of the data was developed based on dimensionless groups, but deviations from this were quite large at low ratios of tube diameter to particle diameter and at velocities below the point of minimum pressure drop.

W. J. Merwin

Ergun, S. and Orning, A. A. FLUID FLOW THROUGH RANDOMLY PACKED COLUMNS AND FLUIDIZED BEDS. *Ind. Eng. Chem.* **41**, 1179-1184 (1949) *June.*

Pressure drop measurements were taken for beds of glass and lead spheres, lead shot, Celite spheres, Raschig rings, Berl saddles and other materials. A general equation was developed showing that the ratio of pressure drop to superficial velocity is a linear function of mass flow rate. This same equation is applicable to the expanding bed. As the superficial velocity of gas was increased, it was found that fluidization occurred at the point where the bed had the loosest stable volume. By neglecting one term of the equation, it was found that the expansion depends on the gas properties and flow rates only through the product of viscosity multiplied by superficial velocity.

W. J. Merwin

Farbar, L. FLOW CHARACTERISTICS OF SOLIDS-GAS MIXTURES. *Ind. Eng. Chem.* **41**, 1184-1191 (1949) *June.*

Qualitative observations on the flow of gas-solid mixtures in horizontal and vertical conduits are given. Pressure drop measurements were made over a two ft section of horizontal and of vertical Pyrex glass tubing. Air velocities ranged from 50 to 150 fps. Plots of pressure drop versus flow rate are presented.

W. J. Merwin

Forsythe, W. L., Jr. and Hertwig, W. R. ATTRITION CHARACTERISTICS OF FLUID CRACKING CATALYSTS. *Ind. Eng. Chem.* **41**, 1200-1206 (1949) *June.*

The attrition resistance of fluid cracking catalysts was studied in a one in. diameter glass column by using a high velocity air jet entering at the bottom. The increase in the amount of

—325 mesh material was taken as a measure of extent of attrition. It was found that microspheroidal catalysts show a considerably greater attrition resistance than ground catalysts, but that the attrition resistance of ground catalysts improves with time. The presence of fine particles reduces the attrition rate of the coarser particles.

W. J. Merwin

Gilliland, E. R. and Mason, E. A. GAS AND SOLID MIXING IN FLUIDIZED BEDS. *Ind. Eng. Chem.* 41, 1191-1196 (1949) *June.*

Gas mixing in a fluidized bed was studied by introducing a tracer gas into the middle region of a fluidized bed and testing for this gas above and below the injection point. It was found that for high L/D ratios the back mixing is relatively small, and that reaction rate studies could be correlated on the basis of piston flow. The mixing of the solids was studied by using a heated section of a fluidized bed situated above a cooled section and by making longitudinal and radial temperature surveys of the two sections. It was found that the solids flow upward in the center of the tube and downward along the walls. The rate of solids mixing was very rapid and relatively constant temperatures could be obtained throughout the bed despite a wide variation in rate of heat release.

W. J. Merwin

Happel, J. PRESSURE DROP DUE TO VAPOR FLOW THROUGH MOVING BEDS. *Ind. Eng. Chem.* 41, 1161-1174 (1949) *June.*

The previous work on pressure drop through beds of solids is briefly reviewed. Experiments were made to determine pressure drop through moving beds of granular, spherical and pellet types of catalyst ranging from 4 to 60 mesh. Concurrent and countercurrent flow was used. The best correlation of the data (±12% deviation) involved the use of a modified friction factor and a modified Reynolds number, the modification being the inclusion of a term for the voidage in the bed. A table is presented showing estimated pressure drops calculated by the various methods existing in the literature. The author's correlation was applied to a number of tests on commercial TCC units and the results checked to ±25%.

W. J. Merwin

Hariu, O. H. and Molstad, M. C. PRESSURE DROP IN VERTICAL TUBES IN TRANSPORT OF SOLIDS BY GASES. *Ind. Eng. Chem.* 41, 1148-1160 (1949) *June.*

Total pressure drop and static pressure drop measurements were made on small diameter glass tubes when transporting solids. The dispersed solids density was measured directly and the average particle velocity, slip velocity, and solids static pressure drop were calculated. It was found that the total pressure drop can be considered the sum of that due to gas flow alone, and a solids pressure drop. The latter is made up of a solids static head, solids friction loss and an acceleration pressure drop. The acceleration pressure drop was found to be a significant portion of the total. Equations were developed for calculating the variation of pressure drop and solids velocity with distance in the accelerating section.

W. J. Merwin

Leva, M., Weintraub, M., Grummer, M. and Pollchik, M. FLUIDIZATION OF AN ANTHRACITE COAL. *Ind. Eng. Chem.* 41, 1206-1212 (1949) *June.*

The previously published mathematical treatment of fluidization behavior is briefly reviewed. A plot of new data obtained on the fluidization of anthracite coal is presented. In correlating this data with earlier results, it was necessary to take into account the internal porosity of the particles in estimating the voidage. To estimate the voidage of porous materials, it is suggested that the shape factor of the particles be estimated by comparison with particles of known shape factor, and then use this value together with suitable pressure drop data in an equation for calculation of the effective voids in the bed.

W. J. Merwin

Lewis, W. K., Gilliland, E. R. and Bauer, W. C. CHARACTERISTICS OF FLUIDIZED PARTICLES. *Ind. Eng. Chem.* **41**, 1104-1117 (1949) *June.*

In a rather comprehensive article, data are presented on bed density and pressure drop obtained in batchwise and in continuously fluidized beds. Two methods of correlating the batch fluidization data are presented. Knowing the physical properties of the solid, it is possible to predict the fluidized bed density. For continuous fluidization it was found that the slip velocity (average gas velocity minus average solid velocity) is independent of gas velocity and solid feed rate. The slip velocities for large particles agree well with the predicted free falling velocities, but for small particles the actual slip velocity is higher than the predicted.

W. J. Merwin

Lewis, W. K., Gilliland, E. R. and McBride, G. T., Jr. GASIFICATION OF CARBON BY CARBON DIOXIDE IN FLUIDIZED POWDER BED. *Ind. Eng. Chem.* **41**, 1213-1226 (1949) *June.*

A study was made of the reaction of CO_2 with anthracite and with retort coke in a fluidized bed at atmospheric pressure and over a temperature range of 1475°-2000°F. The partial pressure of CO_2 was varied from 0.05 to 1 atmosphere by the addition of N_2 and CO as diluents. Decomposition of CO_2 was as high as 90% in some cases. It was found that the higher the temperature and the greater the CO_2 partial pressure, the greater will be the reaction rate. The presence of CO as diluent exerted a greater depressing effect on the rate than did N_2. The data obtained are tabulated and correlated graphically. A rather lengthy and involved discussion of the correlation is given. Charts are presented by means of which it is possible to determine directly the amount of carbon required in the bed once the operating pressure, feed rates, and desired CO_2 conversion are known.

W. J. Merwin

Lewis, W. K., Gilliland, E. R. and Reed, W. A. REACTION OF METHANE WITH COPPER OXIDE IN A FLUIDIZED BED. *Ind. Eng. Chem.* **41**, 1227-1237 (1949) *June.*

Data and graphs are presented on the reaction of copper oxide with methane to form CO and H_2. In a laboratory fluidization unit with a 4 ft bed depth at 1640°F and 1 atmosphere, 94% methane decomposition was obtained with a selectivity of 92%. Higher conversions could be obtained by the use of higher temperatures or greater bed depths. The best form of copper oxide was found to be 15% copper oxide deposited on silica gel. Data are also presented on the reaction of methane with CO_2 and of methane with steam. The data are correlated on the assumption that the limiting factor is the reaction of carbon dioxide and water vapor with methane.

W. J. Merwin

McCune, L. K. and Wilhelm, R. H. MASS AND MOMENTUM TRANSFER IN SOLID-LIQUID SYSTEM. *Ind. Eng. Chem.* **41**, 1124-1134 (1949) *June.*

The transfer of beta-naphthol to water was studied, and the measured variables were water flow rate, exit concentration, water temperature, particle and bed characteristics and pressure drop. For these data, the correlating variables used were the J factor, Reynolds number, friction factor, and drag coefficient. It is pointed out that the mass transfer rate per unit pressure drop is greater for a fluidized bed than for a fixed bed.

W. J. Merwin

Matheson, G. L., Herbst, W. A. and Holt, P. H. CHARACTERISTICS OF FLUID-SOLID SYSTEMS. *Ind. Eng. Chem.* **41**, 1099-1117 (1949) *June.*

General observations on fluidization behavior are presented. Bed density was found to decrease with increase in velocity and a decrease in particle size, while the type of gas used for fluidizing had no influence. The maximum bed density was correlated with particle density and weight mean particle diameter. The viscosity of fluidized systems was measured with

a modified Stormer viscosimeter and it was found that the viscosity increases as particle size and particle density increase. Small amounts of fines decrease the viscosity of a coarse solid markedly.

W. J. Merwin

Meissner, H. P. and Mickley, H. S. REMOVAL OF MISTS AND DUSTS FROM AIR BY BEDS OF FLUIDIZED SOLIDS. *Ind. Eng. Chem.* **41**, 1238-1242 (1949) *June.*

A study was made of the removal of sulfuric acid droplets, 2 to 14 microns in diameter, from air by the use of a fluidized bed. Non porous materials, such as silica and glass beads, showed a very short life, but silica gel, microspheres, and alumina picked up 5% by weight of mist before sticking occurred. Removal efficiency was constant during the life of the beds, and was independent of the inlet concentration. Removal efficiency improved with increasing bed density, and with increasing gas velocity. The maximum removal efficiency obtained in the experimental work was 90%.

W. J. Merwin

Mickley, H. S. and Trilling, C. A. HEAT TRANSFER CHARACTERISTICS OF FLUIDIZED BEDS. *Ind. Eng. Chem.* **41**, 1135-1148 (1949) *June.*

The effect of size and concentration of solid particles, superficial velocity of gas, and two different equipment designs on rate of heat transfer in a fluidized bed were investigated. Glass spheres ranging from 0.002 to 0.02 in. diameter were suspended in a stream of air flowing from 0.8 to 15 fps. One apparatus was internally heated, while the other was externally heated. Heat transfer coefficients of 10-120 Btu/hr/sq ft/°F were obtained. Radial and longitudinal temperature gradients were nonexistent. For internally heated beds, the rate of heat transfer was directly proportional to the bed density and inversely proportional to the average particle diameter. For the externally heated tube, the superficial gas velocity was found to have an effect on rate of heat transfer in addition to the previously mentioned two variables.

W. J. Merwin

Morse, R. D. FLUIDIZATION OF GRANULAR SOLIDS. *Ind. Eng. Chem.* **41**, 1117-1124 (1949) *June.*

The work of Carman and Kozeny on pressure drop in fixed beds is reviewed. The existing literature data on pressure drops in fluidized beds are expressed in terms of the Carman-Kozeny equations, and plots are shown. It is concluded that positive deviations from the Carman-Kozeny correlation are evidence of poor quality fluidization. Negative deviations, in the case of fine sand particles fluidized with air at Reynolds numbers below 10, are explained by the author as being due to clustering of the fine particles.

W. J. Merwin

Murphy, W. J. FLUIDIZATION NOMENCLATURE AND SYMBOLS. *Ind. Eng. Chem.* **41**, 1249-1250 (1949) *June.*

Definitions of common terms used in fluidization work are presented and a tabulation of letter symbols and their meanings is given.

W. J. Merwin

Ramser, J. H. and Hickey, J. W. CATALYST LOSS RECORDER FOR CATALYTIC CRACKING UNITS. *Ind. Eng. Chem.* **41**, 1244-1247 (1949) *June.*

A detailed description is presented of an instrument which continuously indicates and records the amount of catalyst carried away with the flue gas. Light is passed through the flue gas and the emf generated in a thermopile is taken as a measure of solids concentration. Flue gas velocity is determined by a reversed type of Pitot tube. These two measurements are then multiplied to indicate the amount of catalyst loss. By an integrating device, the accumulated catalyst loss can be obtained.

W. J. Merwin

Stoker, R. L. EROSION DUE TO DUST PARTICLES IN A GAS STREAM. *Ind. Eng. Chem.* **41**, 1196-1199 (1949) *June.*

The results of preliminary experiments on erosion caused by dust particles in a gas stream are reported. Targets of iron sheet and of plaster were sandblasted at different jet veloci-

ties and angles of impingement with different entrained dusts. The amount of erosion was determined from the loss in weight of the targets. It was found that the higher the velocity, the greater the rate of erosion. Maximum erosive action was obtained at an impingement angle of 30°. The plaster specimens eroded more rapidly than the iron specimens and the author suggests the use of plaster for an accelerated erosion test.

W. J. Merwin

Wall, C. J. and Ash, W. J. FLUID-SOLID AIR SIZER AND DRYER. *Ind. Eng. Chem.* **41**, 1247-1249 (1949) *June.*

A unit for the continuous drying and sizing of dolomite is described and operating conditions and results are given. The purpose of the unit is to provide dry, dust-free feed for a rotary kiln. The unit is 5 ft 8 in. diameter and 15 ft 6 in. high and has a capacity of 45 tons of feed per hr. Indications are that separations from 20 to 100 mesh can be obtained with the unit. Mesh of separation is defined as that mesh on which the undersize product registers 1.5%.

W. J. Merwin

Distillation

Kemp, H. S. and Pyle, C. HYDRAULIC GRADIENT ACROSS VARIOUS BUBBLE-CAP PLATES. *Chem. Eng. Progress* **45**, 435-451 (1949) *July.*

A hydraulic head is required for liquid flow on a plate across the bubble caps from the downcomer of the plate above to the overflow to the plate below. If this is too great, vapor is forced toward the overflow causing entrainment. Also some leakage through risers occurs. Other factors such as plate stability and capacity must be considered. A method of plate design based on data for 3 and 4 in. caps is presented.

J. D. Parent

Mixing

Wingard, R. E. and Crain, C. M., Jr. MIXING EFFICIENCY STUDIES: RATES OF MIXING AND POWER CONSUMPTION OF THE TWO-BLADE PADDLE AND THE HOESCH STIRRER. *J. Southern Research* **1**, 9-11 (1949) *July.*

Power requirement and solution time for two types of agitators were studied at speeds of 20 to 330 rpm under different conditions of baffling. The two types of stirrers were the two-blade flat paddle type and the Hoesch type, the latter consisting of two crossed shovels with two vertical vanes equally spaced in each of the four quadrants created by the shovels, all fastened to retainer rings at the top and bottom. Solution times in water of two salts, sodium chloride and potassium dichromate, were used. Time required to reach 14.75 grains per gal at various agitator speeds was used as the criterion of mixing efficiency. At lower speed ranges (20-150 rpm), the Hoesch stirrer required more time than the two-blade paddle to produce the desired concentration, but at higher speeds (150-330 rpm) the time for the former approached that of the latter. The power requirement for the latter was nearly four times that of the former. Baffles increase the rate of solution but at a considerable increase in power requirement.

C. L. Tsaros

Separation

Hibshman, H. J. SEPARATION OF HYDROCARBONS BY SOLVENT EXTRACTION. *Ind. Eng. Chem.* **41**, 1366-1369 (1949) *July.*

Equations relating separation selectivities for distillation (relative volatility), liquid-liquid extraction, and vapor-liquid extraction have been derived rigorously. For the separation of components which obey perfect gas and solution laws the product of the first two selectivities is shown to equal the third.

C. L. Tsaros

Hibshman, H. J. SEPARATION BY CHEMICAL TYPE AND MOLECULAR WEIGHT. *Ind. Eng. Chem.* 41, 1369-1374 (1949) *July.*

Partial pressures of several paraffins, naphthenes, aromatics, and naphthalene over solutions of dimethyl-phthalate were determined at 212°F. The ratio of observed partial pressure to that calculated from Raoult's Law is termed J-factor. A plot of J-factor at infinite dilution (J_{max}) vs. boiling point with chemical type (paraffin, naphthene, etc.) as parameter was made, and from this plot maximum selectivities for vapor-liquid and liquid-liquid systems have been calculated. Correlation of calculated and observed selectivities for toluene and n-heptane in phenol solvent is excellent. It was found that: (1) ease of separating unsubstituted aromatics from other chemical types increases with molecular weight; (2) the order of extraction from a mixture of chemical types is unsubstituted aromatics, benzene homologs, naphthenes, and paraffins; and (3) above 200°F midpoint, the boiling range of a mixture separable according to chemical type by liquid-liquid extraction is roughly three times that separable by vapor-liquid extraction.

C. L. Tsaros

The following article, the abstract for which appears on the page indicated, is also called to your attention:

Edmister, W. C. and McGarry, R. J. GAS COMPRESSOR DESIGN. p. 185.

11. PROCESS EQUIPMENT AND INSTRUMENTATION

Boiler Maintenance

Juhasz, S. SULFUR, DEW POINT AND BOILER AVAILABILITY. *Combustion* 20, 55-58 (1949) *June.*

The sulfur content of fuel and flue gas is discussed in relation to deposits and corrosion of boiler and superheater surfaces. Problems of dew-point measurement are outlined, and a dew-point meter developed by the author is introduced. The economics of corrosion-resisting materials is considered and means of reducing corrosion difficulties are analyzed.

Author's abstract

Coal Conveyor

Sullivan, G. F. TESTS SCHEDULED SOON ON STAINLESS STEEL COAL CONVEYOR BELTS. *Iron Age* 163, 133-134 (1949) *June* 16.

Four stainless steel coal conveyor belts will soon be subjected to large-scale operating tests under varied conditions. The first cost of a 20-gage type 302 stainless belt is one-third to one-fourth the cost of a comparable rubber belt, and the weight is only one-fifth as much. Preliminary tests show practically no stretch on starting, indicating horsepower requirements about one-fourth as great as required for rubber belting. The non-combustible feature of the steel belt is also an advantage.

W. E. Ball

Control Systems

Gildersleeve, N. ANALYTICAL INSTRUMENTS IN AUTOMATIC CONTROL SYSTEMS. *Petroleum Refiner* 28, 133-140 (1949) *June.*

Analytical instruments for control purposes may be divided into four groups: (1) mass spectrometer type; (2) absorption spectroscopy type; (3) instruments measuring physical properties of two or three component systems; (4) instruments which are specific for certain substances. Each of these groups are discussed by the author and diagrams are presented

showing their working principles. Diagrams are also presented showing the application of analyzer instruments to control of distillation columns, atmosphere-gas generators, and for blending gasoline with Tetraethyl lead.

W. J. Merwin

Oppelt, W. FUNDAMENTALS OF AUTOMATIC CONTROL. *Engrs. Digest* **10**, 184-189 (1949) June from "Fundamentals of Automatic Control," *Wolfenbüttler-Verlagsantalt g.m.b.H.*, Hanover, 1947; "Graphical Methods for Complex Multiplication," *A.E.U.*, Vol. 2, 1948, p. 76-78; "New Methods for Assessing the Stability of Automatic Control Processes," *Die Technik*, 3, No. 7, 312-314 (1948) *July*.

This article is itself an abstract of a book on fundamentals of automatic control. Diagrams are presented illustrating the principles of the following control elements: (1) indicators and pick-ups for measuring electrical quantities; (2) differentiating elements; (3) power switches and amplifiers; (4) restoring devices; (5) pilot valves and servo control units; and (6) controller elements for varying the reference datum.

W. J. Merwin

Heating Element

SELF-CONTROLLED HEATING ELEMENT. *Engrs. Digest* **10**, 205 (1949) *June* from *The New Zealand Electrical Journal*, **22**, No. 1, 63 (1949) *January*.

A drawing is presented of a heating element whose case is shaped so that it can expand and contract and thereby make or break a circuit. The need for a bimetallic strip is thereby eliminated. It is claimed that temperature can be controlled to within one or two degrees over the range 120° to 420°F.

W. J. Merwin

Pneumatic Feeder

Albright, C. W., Holden, J. H., Simons, H. P. and Schmidt, L. D. PNEUMATIC FEEDER FOR FINELY DIVIDED SOLIDS. *Chem. Eng.* **56**, 108-111 (1949) *June*.

This device utilizes a fluidized bed and allows the fluidized material to overflow into a centrally located tube, which permits the material to be removed from the system. It is claimed that a steady flow of coal can be obtained at coal-air ratios of about 200:1. Sketches of the apparatus and test results are presented.

W. J. Merwin

Water Cooling

Hall, W. A. and Weston, R. F. MAINTENANCE OF HEAT TRANSFER BY COOLING WATER TREATMENT. *Ind. Eng. Chem.* **41**, 1409-1412 (1949) *July*.

A simple method is described by which exchanger fouling can be evaluated in terms of throughput capacity. Results of a study of plant equipment are presented which demonstrate the applicability and usefulness of the method. The fouling encountered was caused by slime deposits from the cooling water. Bacteriological, chemical, physical, and fouling data are given for two systems, both with and without water treatment. Water treatment consisted of phenolic-type compounds in one case and chlorination in the other.

Authors' abstract

12. MATERIALS OF CONSTRUCTION

Corrosion

Bagger, N. B. HOW TO SELECT ANODE MATERIALS FOR CATHODIC PROTECTION AGAINST CORROSION. *Materials & Methods* 30, 47-49 (1949) *July.*

When selecting a specific anode metal it is necessary to consider the following characteristics: (1) potential between the anode metal and the metal to be protected; (2) electrochemical equivalent of the anode metal; (3) polarization characteristics of the anode metal with respect to time, environment and anode current density; and (4) uniformity of the anode metal composition. Typical examples of the use of magnesium anodes are given.

B. E. Hunt

Kimmel, A. L. SPECIAL ANODES FOR THE CATHODIC PROTECTION OF WATER TANKS. *Corrosion* 5, 217-220 (1949) *July.*

Experiments concerning the cathodic protection of water tanks with Mg bearing anodes are described. After an initial deposition of a film of $Mg(OH)_2$ on the tank surface, the current density could be reduced since the current flow serves only to maintain the film. It would be possible to use an inert cathode if the surface of the tank were coated with an alkaline earth coating.

B. E. Hunt

CORROSION PROTECTION FOR TANKS BY REINFORCED GUNITE LININGS. *Petroleum Processing* 4, 784-788 (1949) *July.*

A detailed procedure for the application of reinforced gunite linings to storage tanks is given. The use of reinforcement prevents spalling which occurs with thinner unreinforced coatings. Manpower and material requirements are itemized for typical installations. Although first cost of guniting is 50 to 90% of the cost of replacing the steel, the subsequent maintenance and replacement costs are practically negligible.

B. E. Hunt

Refractories

Giannone, A. ASSESSMENT OF THE RESISTANCE OF REFRACTORY MATERIALS TO SUDDEN TEMPERATURE VARIATIONS. *Engrs. Digest* 10, 189-192 (1949) *June* from *Il Calore* 19, No. 11, 398-401 (1948) *November.*

An important factor in the design and operation of furnaces is the resistance of refractory materials to sudden temperature variations. In this article a method is presented for graphical determination of the stresses in a refractory layer subjected to a given temperature cycle. For these calculations it is necessary to know the freedom of movement, the coefficient of thermal expansion, the modulus of elasticity, rupture strength, and temperature distribution. For the determination of the latter, the author recommends measuring the temperatures within a refractory panel mounted above a vertical furnace. By varying the rate of temperature rise or cooling, it will be possible to determine the limit range of temperature changes beyond which the stresses become excessive. The maximum tensile stresses will generally be more dangerous, since they correspond to a lower value of the rupture strength.

W. E. Ball

The following articles, the abstracts for which appear on the pages indicated, are also called to your attention:

Dravnieks, A. and McDonald, H. J. HIGH TEMPERATURE CORROSION OF METALS. p. 194.

Gulbransen, E. A. KINETIC AND STRUCTURAL FACTORS INVOLVED IN OXIDATION OF METALS. p. 194.

Hackerman, N. and Schmidt, H. R. THE ROLE OF ADSORPTION FROM SOLUTION IN CORROSION INHIBITOR ACTION. p. 194.

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